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ABSTRACT

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Automatic Processing of Word Meaning by Bilingual Children: Intralingual and Interlingual Interference

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Abstract

Automatic processing or word meaning by bilingual children was studied in a picture-word interference task. Children, fluent in French and English, named pictures as rapidly as possible while attempting to ignore distractor words printed inside the pictures' borders. The printed distractors interfered with naming both on intralingual trials, for which the distractor and name language were the same, and on interlingual trials, for which they were different. The pattern of interference across the six levels of name-distractor relation was similar for the intralingual and interlingual conditions and indicated that at least part of the interferernce occurred at a semantic level. The results question whether an "input switch" operates for bilingual word processing and carry implications for the question of single versus dual conceptual systems in bilingual children.

Automatic Processing of Word Meaning by Bilingual Children: Intralingual and Interlingual Interference

One issue in the study of bilingualism concerns whether a switching mechanism controls the bilingual's engagement of different language systems. Clearly, such a mechanism functions at some level because bilinguals can produce speech in one language without experiencing intrusions from the other language; at a minimum, then, bilinguals possess a functional language "output" switch. Macnamara (Macnamara, Krauthammer, & Bolgar, 1968; Macnamara & Kushnir, 1971) hypothesized that bilinguals possess an "input" switch as well, by which a single language system is activated for comprehension. Supporting this view, Macnamara and Kushnir (1971) found that bilinguals more rapidly comprehend unilingual text passages (which require no switching of language during comprehension) than multilingual passages (see also Kolers, 1966b).

However, results from studies using a bilingual version of the Stroop task argue against the functioning of an input switch. In the traditional Stroop task, subjects name the ink colors in which conflicting color names are printed (Stroop, 1935). Subjects typically experience considerable interference from the words on this task despite their attempt to avoid word processing. Because the task directs the subject's attention to color naming rather than word processing, the word processing which does occur is assumed to occur automatically (see LaBerge & Samuels, 1974, and Shiffrin & Schneider, 1977, for discussions of automaticity). In bilingual versions of the task, the language of naming and the language of print may be either the same (intralingual interference) or different (interlingual interference). Utilizing this paradigm, several investigators have found that subjects experience interference on interlingual trials, though usually less than on intralingual trials (Dyer, 1971;

Obler & Albert, 1978; Preston & Lambert, 1969). Similar results were found in a recent study by Ehri and Ryan (1980) who utilized a picture-word variant of the Stroop task (in which subjects name pictures while trying to ignore distractor words printed inside the pictures). Thus, bilingual subjects are apparently unable to avoid processing printed words in one language, even while they use a different language to name ink colors or pictures.

One important limitation of the bilingual Stroop and picture-word interference studies is that they do not permit inferences regarding semantic processing of the words in the distractor language. Such inferences are not possible because there was no control for nonsemantic sources of interference such as distractor pronounceability, or the fact that distractor words correspond to familiar discrepant verbal responses. For instance, Preston and Lambert (1969) and Obler and Albert (1978) each compared naming time for ink colors of color words with that for ink colors of nonletter designs, while Ehri and Ryan (1980) compared naming time for pictures containing discrepant names with that for pictures containing a string of Xs. These comparisons do not isolate a semantic component of the interference effect, though such a component has been identified with unilingual versions of the picture-word interference task (Guttentag & Haith, 1978; Rosinski, 1977). Indeed, the greater interference produced by intralingual than interlingual distractors might reflect semantic interference on intralingual trials but lack of semantic processing on interlingual trials. Thus, the question of the existence of an "input switch" for semantic processing by bilinguals has not yet been resolved.

The present study utilized the picture-naming interference task to test for the operation of an input-switch mechanism in bilinguals, and also permitted examination of whether interlingual interference operates at a semantic level. In addition, an age factor was introduced. Since previous studies of input switching have only used adult bilinguals, questions about whether age changes occur in the use of an "input

switch" have not been explored. Younger subjects might find it necessary to effortfully activate a language system to comprehend information in that language, whereas adults may process the input so automatically that they are unable to deactivate a langauge system even when it is advantageous to do so. If so, children would experience less interlingual interference than adults. On the other hand, adults may be able to switch off the semantic processing of words in a particular language, but it may take some years to develop that skill. If so, children would experience more interlingual interference than adults.

The present study included six conditions which isolate a variety of components of the picture-naming interference effect (Guttentag & Haith, 1978) and thereby avoids the methodological limitations of previous studies The six conditions were: (1) blank (pictures presented alone); (2) nonpronounceable (pictures contained a nonpronounceable distractor letter string); (3) pronounceable pseudoword (pronounceable nonword distractors); (4) between-category (picture and distractor from different conceptual categories); (5) within-category (picture and distractor from the same conceptual category); (6) congruent (distractor semantically congruent with the picture). The difference between conditions one (blank) and two (nonpronounceable) isolates interference attributable to the presence of distractor letters; the difference between conditions two and three (pronounceable) isolates interference attributable to the distractor pronounceability; the difference between conditions three and four (between-category) isolates interference attributable to "wordness"(ie., lexicality and associated relations with verbal responses), and the difference between conditions four and five (within-category) isolates interference attributable to word meaning. Condition six (congruent) provided a second indicator of semantic processing of the distractor words on interlingual trials.

We also tested three types of subjects: balanced bilinguals, English-dominant bilinguals, and French-dominant bilinguals. There is some evidence to suggest that

subjects experience more interference from dominant-language distractors than from second-language distractors (Obler & Albert, 1978). The availability of subjects who were dominant in different languages provided a balance for cross-language and same-language processing automaticity which has not been available in prior studies. Ehri and Ryan (1980) reported more cross-language than same-language interference on early exposure to a picture-word interference task which reversed with additional familiarity. However, the differential effects held only for subjects who named pictures in English. Unfortunately, most of their subjects were English dominant which leaves the possibility open that the results were peculiar either to the specific language experiences of their subjects or to a particular choice of English words and their Spanish translations.

Method

Subjects. Participants in the study attended the Lycée Internationale, a French public school located in Saint Germaine-en-Laye, France. The Lycée educates children from nursery school age through the first year of college. Half of the Lycée students are French nationals, and the remaining half hold foreign nationality.

We selected 30 children from the Lycée's total population based on age and language history. The age range was restricted by several considerations. Children younger than approximately 8 years were not tested because so few could read all of the stimulus words in both languages and/or meet our bilingualism criteria. Older children's intense studies limited their participation. The children tested fell into one of two age groups (n = 15 each): (a) younger, (M = 9-2 years; range 7-11 to 10-6); and (b) older, (M = 12-5 years; range 11-0 to 14-8). Thus, the two age groups were composed of elementary school and junior high school students, respectively. These children also fell into one of three bilingual categories (n = 10 each): (a) balanced bilinguals; (b) English-dominant bilinguals; or (c) French-dominant bilinguals. An equal number of younger and older children were included in each

bilingual group. Balanced bilinguals either learned to speak English and French simultaneously at home (n = 4) or learned both languages before the age of 4 years in the home and through exposure to an intensive second-language environment (n = 6). For example, one parent might have conversed with the child solely in English while the other conversed solely in French; or, both parents might have conversed with the child in French and English, but the family lived in America when the child was young (birth to 4 years) and then moved to France. Most of the children attended bilingual schools or a school that favored the language not favored in the home. Parents of balanced bilinguals reported making additional efforts to balance the child's language experience through governesses, vacations, and tutoring. Since the balanced bilinguals tended to come from families in which one parent was French and the other American or British, great emphasis was placed on the child's bilingual abilities. English-dominant bilinguals learned English as their first language but experienced at least three years in an intensive French-speaking environment. For example, the child's parents might have conversed with the child only in English, but the child spoke mainly French at school for at least three years while living in a French-speaking country. French-dominant bilinguals were comparable to the English-dominant bilinguals but had learned French as their first language and English as their second language. The Lycée judged all of these children to be fluent in both French and English through their performance on a series of written and verbal screening tests. The children were required to spend part of their day in French speaking and reading classes and part in English speaking and reading classes. All of the children reported feeling approximately equally proficient in the two languages though some felt somewhat more comfortable speaking or reading in one than the other.[1]

Stimulus materials. The pictures for the picture-naming task were 12 line drawings, three from each of four categories: (a) parts of the body (leg, hand, and

foot); (b) food (milk, egg, and apple); (c) celestial objects (moon, cloud, and star); and (d) animals (dog, bear, and cow). The category exemplars were chosen after extensive screening, and satisfied the following criteria: 1) Each item was familiar to children of all ages and all nationalities tested; 2) the name of the item was not a cross-language cognate or visually or acoustically confusable with any other noun either within- or across- languages; 3) the names of the items did not exceed six letters in either language.

The pictures were drawn on sheets of paper. Each sheet contained the same 12 pictures but in different positions and with different kinds of distractors. The distractors were words or nonsense letter-strings typed in lower case in the center of the picture. The set of 12 words referred to the same items as the picture set, i.e., leg, hand, foot, etc.

Six sheets were used for the French distractor condition and six for the English distractor condition. Within each language condition, the six sheets corresponded to one of the following distractor conditions:

1) Blank. Each picture appeared with no printed material.

2) Nonpronounceable. Each picture contained a nonpronounceable letter-string created by substituting consonants for vowels in the pronounceable pseudowords.

3) Pronounceable pseud.words. Each picture contained a pronounceable nonsense word that obeyed orthographic rules within the language. These nonsense words were matched to the picture-name words in letter frequency and length.

4) Between-category distraction. Each of 12 pictures contained a name from the other pictures in a different semantic category, e.g., a dog containing the word "apple" or "pomme."

5) Within-category distraction. Each of the 12 pictures contained the name of one of the other pictures from the same category, e.g., a dog containing the word "cow" or "vache."

6) Congruent. Each picture contained the correct name of the picture.

In addition to these stimulus materials for the primary task, two sheets were prepared for a picture-word matching task, one with French words and one with English words. A list of the 12 experimental words mixed with a list of 12 anagrams of these words, appeared in one column on the left hand side of the page. The anagrams began with the same letter as the original word. On the right side of the page were the 12 experimental pictures, also in a single column.

Design. The design of the study was a 2 (age) X 3 (bilingual category) X 2 (naming language) X 2 (distractor language) X 6 (distractor condition) mixed factorial design, with age (younger vs. older) and bilingual category (balanced, English dominant, and French dominant) as between-subject factors and naming language (English vs. French), distractor-language (English vs. French), and distractor condition (blank, nonpronounceable pseudowords, pronounceable pseudowords, between-category, within-category, and congruent) as within-subject factors. The naming-language factor refers to the language in which the child named the pictures. The distractor-language factor refers to the language in which the printed distractor words were written. The orders of the naming language, the distractor language, and the distractor conditions were counterbalanced across subjects. The smallest experimental cell contained five subjects.

Procedure. Children were seen individually. An experimenter, bilingual in French and English, interacted with the child. The children, sent to the testing room by their teachers, had no prior contact with the experimenter. The experimenter conversed with the child in whichever language the child was about to name the pictures. The child was told that he or she would be asked to name pictures as rapidly as possible (first in one language, and then in the other language), but that it was necessary to make sure that the subject and the experimenter were using the

same names. The child was then asked to name the experimental pictures from a practice sheet of pictures that contained no letters or words. If there were any discrepancies in word choice, the subject was corrected and then retested on the problematic pictures until all the pictures were easily named. A second practice sheet was shown to the subject corresponding to the nonpronounceable pseudoword condition. (These nonpronounceable pseudowords differed from those in the experimental trials.) The subject was told that sometimes there would be letters or words inside the pictures but to ignore them as they would be confusing. The subject was then asked to name all the pictures as rapidly as possible and to ignore the printed material.

Subjects were then presented 12 sheets in sequence, 6 from one distractor language (e.g., French) followed by 6 from the other distractor language (e.g., English). The order of the distractor conditions remained the same across the two language subsets. Subjects named the pictures on the 12 sheets in either English or French. After a brief rest, subjects completed the same task but named the pictures in the other language. (The experimenter gave the instructions for this second, distractor language condition in the language subjects were about to use for picture naming.) The time required to name the 12 pictures on each sheet (measured with the aid of a hand-held stopwatch) and errors were recorded, and each session was audiotaped. Subjects were reminded before each sheet was presented to name the pictures as fast as possible and to ignore the print inside the pictures.

After the experiment proper, the picture-word matching task was presented to determine children's knowledge of the meaning of the French and English words used in the experiment. A sheet was presented to the child that contained the experimental words, mixed with anagrams, and the experimental pictures. The child was asked to draw a line from the picture to its correct label; warning was given that there were some "mixed-up words" in the list. The subject worked on the sheet for one language

first and then on the sheet for the other language. All subjects correctly identified all words on both language lists.

After both lists were completed, the subject was asked about his or her language experience, the languages spoken by the mother and father, and what languages were spoken at home. Subjects were also asked if they felt equally competent in both languages or whether they were better or felt more comfortable in one or the other. Finally, children were given a "bon-bon" for their efforts. The entire procedure required approximately 30 minutes.

Teachers filled out questionnaires concerning the child's competence in French and English, and parents filled out questionnaires about their own and their child's language experience.

Results

The basic datum for the study was the time in sec required to name the 12 pictures in each condition. Tables 1 and 2 present the mean time required to name the pictures in each condition for intralingual and interlingual trials, respectively. Statistical analyses of the error data were not performed since errors occurred on only 2% of the trials.

The question about an input switching mechanism was addressed by comparing the pattern or interference effects on intralingual and interlingual trials. A preliminary analysis revealed no effects or naming in French versus English; consequently, we collapsed across the two intralingual conditions and across the two interlingual conditions to form one "concordance" factor having two levels (intralingual and interlingual). To preview the results, the analyses indicated that all bilingual groups processed distractor words semantically whether or not the words were in the same naming language used for responding. The cross-language semantic interference effect, however, was more restricted for two of the three younger groups than for the older groups.

An overall analysis of variance involving two levels of age, three levels of bilingualism (balanced, English-dominant, French-dominant), two levels of concordance, and six levels of distractor condition, revealed significant main effects of distractor condition, $F(5, 120) = 109.19$, $p < .01$, and age, $F(1, 24) = 21.02$, $p < .01$. Planned comparisons were performed to test for interference attributable to letters, pronounceability, lexicality, and meaning. The analyses for these comparisons involved age, bilingualism, concordance, and distractor condition as factors (except where otherwise noted). As with the overall analysis, there was a significant main effect of age ($p < .01$) in all of these analyses indicating that younger subjects were significantly slower than older subjects at naming the pictures.

Interference by letters. The performance difference between the blank and nonpronounceable conditions provides a measure of interference attributable to the presence of letters. There was a significant letter interference effect, $F(1, 24) = 25.17$, $p < .01$, as well as a significant age x conditions interaction, $F(1, 24) = 6.56$, $p < .05$, with the younger subjects experiencing more letter interference than older subjects. This finding is consistent with results of previous picture-naming interference studies (Guttentag & Haith, 1978).

Interference by pronounceability. The effect of pronounceability on naming can be determined by comparing the nonpronounceable and the pronounceable pseudoword conditions. As for previous work (Guttentag & Haith, 1978), we found a small significant effect of pronounceability, $F(1, 24) = 7.16$, $p < .05$.

Interference by words. The pronounceable pseudoword and between-category conditions were compared to determine the amount of interference produced by lexicality of the word distractors. Between-category words produced significantly more interference than did pronounceable pseudowords, $F(1, 24) = 52.45$, $p < .01$, with the younger subjects experiencing significantly more interference than did the older

subjects $F(1, 24) = 5.99$, $p < .05$.

Interference by semantic categories. Previous research has indicated that, on intralingual versions of the picture-naming interference task, subjects experience more interference from within-category than between-category distractors (Guttentag & Haith, 1978; Rosinski, 1977). This finding indicates that subjects "involuntarily" (or automatically) processed the distractors to a semantic level. In the present study, the comparison or between- and within-category conditions revealed a significant main effect or conditions, $F(1,24) = 11.44$, $p < .01$, without a significant conditions x concordance interaction, $F < 1$. This finding reflected greater interference on within- than betwen- category conditions and suggests that subjects semantically processed the distractors on both intralingual and interlingual trials.

Inspection of Tables 1 and 2 reveals that, although the overall difference between the between- and within-category conditions was significant, the effect was not independently present for the young French-dominant subjects for either the intralingual or interlingual conditions; for the young balanced bilinguals the effect was also absent in the interlingual condition. However, the following analysis of interference by congruent words provides evidence for semantic processing of the distractors by all subject groups.

Insert Table 1 About Here

Insert Table 2 About Here

Interference by congruent words. The effect of congruent distractors on picture-naming latencies differed markedly depending on whether the trial was intra- or interlingual. Naming latencies in the congruent condition were significantly longer on interlingual trials than on intralingual trials, $F(1, 24) = 68.12$, $p < .01$. Indeed, on the intralingual trials, congruent words facilitated naming relative to the blank conditions, $F(1, 24) = 46.01$, $p < .01$. One interpretation of this effect is that subjects only read the words rather than named the pictures.

The effect of congruent distractors is of particular interest on interlingual trials. On these trials, the distractors were semantically congruent with the pictures, but were phonologically discrepant from the correct response. Thus, on interlingual trials, the congruent condition differed from the between- and within-category conditions solely with respect to the nature of the picture-word semantic relationship.

Planned comparisons involving the congruent condition indicated both that congruent words produced more interference than pronounceable pseudowords and less interference than between-or within-cagegory words. Thus, there was an effect of wordness in this condition as well as an indication that the semantic identity between word and picture facilitated naming. Responses were significantly slower in the congruent condition than in the pronounceable pseudoword conditions, $F(1, 24) = 8.85$, $p < .01$, but were significantly faster in the congruent condition than in the between-and within-conditions, $F(1, 24) = 8.95$, $p < .01$, and $F(1, 24) = 43.42$, $p < .001$, respectively. This pattern held for both the young French-dominant and the young balanced-bilingual groups, who failed to show a between- versus within-category difference in the interlingual condition. This finding suggests, therefore, that all subjects, including the young French-dominant and the young balanced-bilingual groups, semantically processed the distractors on interlingual trials.

Effects of language dominance. To test for effects of language dominance, we compared the French-dominant and English-dominant subjects on the two types of intralingual trials (English naming with English distractors, French naming with French distractors), and the two types of interlingual trials (English naming with French distractors, French naming with English distractors). Previous evidence, based on the performance of adults on bilingual versions of the Stroop task (Obler & Albert, 1978), suggested that, in such a comparison, subjects should experience more interference from distractors in their dominant language than their secondary language. Our analysis involved the between- and within-category conditions. In contrast to Obler and Albert's (1978) findings, we found no evidence for type of bilingual x distractor language interaction, $F(1, 16) = 2.35$.[2] Instead, French words produced the largest latencies for all subjects.

Intra- versus interlingual interference. One of the questions underlying the present study was whether bilingual children can switch off processing the meaning of words in their nonactive language. If so, interlingual interference from words should not be found. A less extreme possibility would be that interlingual interference occurs but is not as powerful as intralingual interference. Instead, intralingual and interlingual word interference were approximately equal; to the extent that a difference did occur, interlingual interference was actually greater than intralingual. However, when the combined between- and within category conditions on the intralingual trials, $X = 16.53$, were compared to the combined between- and within- category conditons on the interlingual trials, $X = 17.57$, the planned comparison was not reliable, $F(1, 120) = 2.20$. All three bilingual groups were included in the analysis. (The congruent condition was not included in the comparison because or the inverse interference effects found for this condition on intra- and interlingual trials). The finding did not vary as a function of age.

Discussion

Before discussing our results within the context of the existing literature, several caveats should be made. Except for one study that utilized a bilingual version of the picture-word interference task (Ehri & Ryan, 1980), studies of most relevance to the present one tested subjects on the Stroop task. This task varies in a number of ways from the picture-word interference task. Most notably, the Stroop task employs a smaller set of stimuli (color words) and ones that are probably very well learned. Moreover, in the Stroop studies and in Ehri and Ryan's (1980) study, only adults were tested. In general, these adults were not as thoroughly bilingual as were the children we examined. These differences (in tasks, ages, and degree of bilinguality) may have contributed to some of the disparities we discuss below.

The principal finding of the present study was that, for all subject groups for both intralingual and interlingual trials, the meaning of the distractor words affected picture-naming latencies. Thus, subjects in all groups processed the distractor words automatically to a semantic level even when the distractor language was different from the language of naming. This finding indicates that the bilingual children were unable to selectively switch off processing of the words that appeared in the presumably inactive language, a finding which argues against the operation of an "input switch" in bilinguals. No reliable age changes were found in the ability of subjects to avoid processing the distractor words although two of the younger groups did not manifest semantic interference under all of the relevant conditions. Apparently, by the time bilingual children are nine years of age, they process words in their different languages so automatically that they are unable to switch off semantic processing in one of their languages even when it is advantageous to do so.

Both Macnamara and Kushnir (1971) and Obler and Albert (1978) have argued in favor of an input switch mechanism but have proposed that the mechanism operates automatically, outside of conscious control, to turn on processing in the language

of whatever information is being presented. By this argument, the Stroop and picture-naming interference effect result from the automatic "turning on" (by the distractor words themselves) of word processing in the distractor language. By further assuming that switching, though automatic, takes time, the automatic switch hypothesis can also explain why it takes longer to read multi-language than single-language passages (Kolers, 1966; Macnamara & Kushnir, 1971).

Although the present findings are not completely inconsistent with the operation of an automatic, input-switch mechanism, such a mechanism seems unlikely. Our findings suggest that automatic semantic processing of at least single words occurs under either intralingual or interlingual conditions. Rather than accepting the input-switch hypothesis one can account for the slower comprehension of multilanguage passages in terms of the disruption of subjects' opportunity to use a stable grammatical structure to facilitate word processing since the syntax of languages differs. One testable implication of the automatic-switch hypothesis is that subjects should be unable to process information in two different languages simultaneously. We are currently testing this hypothesis.

The results of the condition in which the direct-translation distractors (the interlingual congruent condition) were used are of special interest. Since congruent words were processed faster than between-category words, semantic facilitation must have occurred in this condition. However, the fact that interlingual congruent words produced longer response times than pseudowords suggests that a nonsemantic interference effect was operating since semantic interference could not have occurred in the interlingual congruent condition. We believe that response competition plays a role in this nonsemantic interference effect. For a bilingual, a distractor word arouses a name-response tendency in the wrong language. Since a picture can also be expected to generate some tendency for naming in the "wrong" language, there are two sources that contribute to pronouncing the distractor word in the interlingual

distractor condition. This tendency must be suppressed which requires extra time. A conclusion from this logic is that the interlingual condition effects probably reflected some role or nonsemantic suppression, but since the specific distractor-naming tendency was not abetted by picture effects, it presumably played a small role.

Contrary to some previous findings (Dyer, 1971; Obler & Albert, 1978; Preston & Lambert, 1969), we found no evidence for greater interference on intralingual than interlingual trials. However, all of the studies finding strong evidence for a difference between intralingual and interlingual trials have utilized the Stroop color-word paradigm, whereas the one previous picture-naming study with bilinguals (Ehri & Ryan, 1980) found very qualified evidence for an effect. It is possible that the differences in performance on intralingual and interlingual trials is unique to the highly restricted stimulus set utilized in the Stroop interference studies and/or to sets of stimuli that are not automatically processed at a semantic level.

Also contrary to the findings of Obler and Albert (1978), we found no effects of language dominance on the pattern of interference effects experienced by subjects. A likely explanation for this discrepancy is that the subjects in the Obler and Albert study may have been more strongly language dominant than were the subjects in the present study. Supporting this interpretation is the finding that Obler and Albert's subjects were much faster in naming pictures in their dominant language than in their secondary language, while, in the present study, subjects were no faster at naming pictures in their dominant than in their secondary language.

Finally, the results of the present study also relate to the issue of single versus dual conceptual systems in bilinguals. One position on this issue holds that a bilingual's two languages are subserved by a single conceptual system (Caramazza & Brones, 1980; Kolers, 1966a; McLeod, 1976). The second position holds that bilinguals possess a separate conceptual system for each language (Kolers, 1963;

Kolers & Gonzales, 1980; Miljkivitach, 1980; Tulving & Colotla, 1970). At present the issue remains unresolved (see Albert & Obler, for a review).

If bilinguals possess two separate conceptual systems, then semantic interference on interlingual trials should have been slight, because the meaning of the distractor should have activated a different conceptual system from the one used for responding. Thus, at a minimum, we should have seen evidence that the interlingual semantic interference was weaker than intralingual semantic interference. If, however, bilinguals possess a single conceptual system, the interference patterns across intralingual and interlingual conditions might be expected to be comparable. The present findings support the single conceptual system view. That is, the nature of the picture-word semantic relationship affected naming latencies on intralingual and interlingual trials similarly, which supports the view that our bilingual children utilized a single conceptual-system. While it is possible that separate conceptual systems functioned earlier in development (or may function later in adulthood), we found no evidence for developmental change across the age range and types of bilingualism tested. As proposed by others (e.g., Kolers & Gonzales, 1980) the conclusion regarding single versus dual semantic representation of words probably will depend on how those words are used in the experimental tests, and the ability of subjects to optimize their performance strategies. An interesting feature of the current test is that subjects tried to ignore the words as opposed to organizing a strategy for their use. It is likely that this task more faithfully taps semantic organization than prior tasks that are confounded by organizational strategies.

Albert and Obler (1978) provide an insightful commentary on the issue of compound (single) versus coordinate (dual) language systems. They suggest that a continuum exists between completely coordinate and completely compound systems and that most bilinguals either lie somewhere between these extremes or possess language

systems that are in part coordinate. While several complex and unresolved issues within the bilingualism literature (e.g., compound versus coordinate and global versus differentiated language systems) are probably best thought of in this way, our results suggest that, at least on the picture-word interference task, children who are thoroughly bilingual lack a functional input switch and utilize a single conceptual system.

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Footnotes

[1] We would like to point out that the composition of our groups was unique. Previous studies of bilingual performance on Stroop and picture-word interference tasks have not employed criteria as strict as ours to define bilingualism. For example, Ehri and Ryan (1980) included as bilinguals subjects who could only identify 75% of the second language stimulus words that were used. In contrast, all of our subjects could identify 100% of the stimulus words in both languages and were intensively exposed to two languages no later than elementary school. We were fortunate to have access to a sample of bilingual children who met a strict definition of bilingualism.

[2] All of our subjects could be classified as "true" bilinguals if a looser criterion of bilingualism is employed. This could explain the lack of differences between our groups. Alternatively, the small sample size may have affected the statistical power of our tests to find reliable differences between the age and bilingualism groups.

Table 1

Mean Latencies (in Sec) on Intralingual Trials
for each Subject Group in each Condition

Subjects	B	NP	P	BT	W	C
Balanced						
Young	12.33	13.86	16.06	18.80	20.48	9.94
Old	8.23	8.33	8.89	11.95	15.50	6.27
English Dominant						
Young	10.79	11.17	13.45	17.96	19.83	7.90
Old	8.98	10.90	12.04	14.11	17.18	7.48
French Dominant						
Young	10.09	12.38	11.34	17.99	17.27	6.95
Old	8.94	9.68	9.86	13.04	14.22	6.18
Mean	9.89	11.05	11.94	15.64	17.41	7.45

Table 2

Mean Latencies (in Sec) on Interlingual Trials
for each Subject Group in each Condition

Subjects	Interlingual Conditions					
	B	NP	P	BT	W	C
Balanced						
Young	13.30	15.75	17.06	23.15	23.41	16.76
Old	9.06	8.80	9.16	10.18	12.98	9.48
English Dominant						
Young	10.77	13.14	12.08	16.42	20.93	14.95
Old	10.87	10.57	12.00	14.64	19.41	16.38
French Dominant						
Young	12.18	14.34	14.17	20.46	20.27	16.39
Old	8.72	9.82	10.82	14.00	15.00	11.86
Mean	10.82	11.90	12.55	16.47	18.66	14.30